DOCUMENT RESUME

ED 031 559 VT 007 860

Wood Substitutes; A Base Syllabus on Wood Technology.
Eastern Kentucky Univ., Richmond.
Pub Date Aug 68
Note-58p.; From NDEA Inst. on Wood Technology (Eastern Kentucky Univ., June 10 Aug. 2, 1968).
EDRS Price MF-$0.50 HC-$3.00
Descriptors-Curriculum Development, *Curriculum Guides, *Industrial Arts, Instructional Improvement, *Resource Materials, Summer Institutes, Teacher Developed Materials, Teacher Education, *Woodworking
Identifiers-*National Defense Education Act Title XI Institute, NDEA Title XI Institute, Wood Substitutes

This curriculum guide is for use by college instructors concerned with expanding traditional woodworking programs. It was developed in a National Defense Education Act summer institute and is based on an outline provided by members of a previous institute. The content concerns wood substitutes which are made to resemble wood and are often used with wood but contain no wood or wood products. Units are (1) The Manufacture of High Pressure Plastic Laminate, (2) Vinylwood Veneers, (3) Vinyl Wrapped Wood Substitutes, (4) Wood Grain Reproduction on Wood and Other Materials, and (5) High Pressure Molded Products. Each unit contains information relative to the development, use, and production of the wood substitutes and a reference bibliography. (EM)

ED031559

C1

WOOD SUBSTITUTES

A
BASE SYLLABUS
ON
WOOD TECHNOLOGY

Prepared by
INSTITUTE PARTICIPANTS

N.D.E.A. INSTITUTE
for advanced study in
INDUSTRIAL ARTS
June 10 - August 2, 1968

VT007860

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL OFFICE OF EDUCATION POSITION OR POLICY.

WOOD SUBSTITUTES

A

BASE SYLLABUS

ON

WOOD TECHNOLOGY

Prepared

by

Participants

in the

Wood Technology

N.D.E.A. Institute

EASTERN KENTUCKY UNIVERSITY

June 10 - August 2, 1968

Institute Staff:

Dr. Jack A. Luy, Director
Dr. William E. Sexton
Mr. Ralph W. Whalin

Printed by:
EKU Graphic Arts Dept.
George Brown, Chrm.

PREFACE

Recently, the area of woodworking has come under much criticism as being too limited in scope and not fully abreast of an advancing technology. Some people have gone as far as to seek its abolition from the industrial arts program in the secondary schools. In reality, however, the importance of woodworking as a phase of industrial arts is probably greater now than ever before. It is conceded, nevertheless, that the scope and content of industrial arts woodworking programs needs to be improved.

Traditionally, a typical woods program is centered upon the use of hand and machine tools with little or no emphasis given to the problem of familiarizing students with technical knowledge of the material itself.

To assist in the upgrading of present programs, students and teachers should, in addition to the use of wood as lumber, be made aware of the various properties of wood and wood products. Of equal importance is a knowledge of new processes and materials used in conjunction with the fabrication, manufacture, and application of wood and wood-related products.

The purpose of the NDEA Institute in Wood Technology held at Eastern Kentucky University during the period June 10 - August 2, 1968, was to provide college level industrial arts woodworking instructors with the opportunity to receive information in depth which they might use to broaden the scope and content of their programs. To this end, the participants have prepared this series of Basic Outlines which attempt to record their experiences during the period of the institute. The "Base Syllabus" prepared by the participants in the 1967 Wood Technology institute was used as a guide in developing the format of this series.

It is hoped that the material covered herein will be applied to the improvement of each participant's woodworking program and lead their students to a greater understanding of wood and wood products.

Jack A. Lux

Institute Director

WOOD SUBSTITUTES

THE MARRIAGE OF OTHER MATERIALS TO WOOD PRODUCTS

Introduction

Trends in todays' fabulous market of new materials are here whether one wants to readily accept them or not. People who work with wood products should be in a position to readily understand the benefits or possibly the disadvantages of the new materials. Nevertheless, we still have essentially three groups or schools of thought. The resistors of wood substitutes, the pushers of wood substitutes, and the non-committed groups are somewhat at arms length in a union of the new technology. The technology of industry is abundant with new materials that only the die-hards fail to accept.

For example, there are a fantastic number of wood simulations that satisfy the most discriminating eye and in some cases, the touch as well. In the consumer market there are basic objections to the fact that it "ain't real wood" when it may be as good or better for certain purposes.

Sometimes we are slow to accept the obvious, for example, people now realize that high pressure plastic laminates are some of the best products ever developed to undergo abuse in the kitchen or perhaps a college dormitory. We must provide a large amount of credit in this media to the technology of adhesives. Another example might be that the consumer now wants plastic drawer slides, not wood or metal. Perhaps one day soon the resistance to plastic, plastic overlays, vinyl wrap-arounds, coverings and wood substitute textures on panels, and printed and engraved reproductions will be readily accepted to provide more furniture and building materials for the most people at a price they can afford.

When defining wood substitutes in the context of its marriage to other man-made materials, we do not lose the identity of wood as a partner to proven high caliber products that may have been completely made of wood substance in the past. In this context, we could say the product should have a wood related substrate with an overlayment or coating of non-woody material that looks like and perhaps feels like wood.

A final observation would be to define a wood substitute as material that is made up entirely without the use of wood substance, imitated in a form that looks and feels like wood and even goes to the extent of containing wood characteristics such as pores and grain. This imitation would often be used in combination with wood.

The N.D.E.A. participants assigned to this unit approached the task of writing this report by attempting to find out the most current material written on the subject of wood substitutes. Letters to industry, field trip visitations, telephone calls, and research in current periodicals and books, were employed in preparing this report. All references may be further identified in each individual unit bibliography.

UNIT I

THE MANUFACTURE OF HIGH PRESSURE PLASTIC LAMINATE

I. History

A. The development of plastic laminates was preceded by the development of "vulcanized fiber."

1. Vulcanized fiber is a one component material--cellulose. However, it is considered a lamination because it is made up of a number of layers or "laminations" of 100 per cent rag-content paper.

2. The vulcanized fiber process was developed and patented on March 29, 1859. Mr. Thomas Taylor of England was the person to whom a patent was awarded.

3. The process was not accepted in England. Taylor brought his ideas to the United States and with the assistance of several businessmen organized the Vulcanized Fibre Company on June 19, 1873 in Newark, Deleware.

4. As the original American patents expired, many small companies began producing vulcanized fibre.

a) The originator of one such company was Mr. J. P. Wright, who originated the Continental Fibre Company in 1905.

b) Wright is given credit for making the first phenolic laminate in 1911. However, Leo Hendrik Baekeland received a patent in 1910 relating to the usage of phenol formaldehyde for impregnating fiberous sheets, but had not yet produced any commercially.

(1) Shortly after Wright developed the usage of phenolic resins in laminating, the Westinghouse Electric Company and the Continental Fibre Company began producing pressure laminates under licences from the General Bakelite Company. Both Westinghouse and Continental had to purchase their resins from the Bakelite Company.

(2) The basic process of heat and pressure setting a resinous impregnated paper thus developed the evolutionary development of today's plastic laminate industry began.

II. A detailed analysis of the makeup of high pressure plastic laminates. (See figure 1).

A. A laminated plastic, in contemporary context, is composed of several superimposed layers of synthetic resin - impregnated fibres (usually paper) which have been bonded together by means of heat and pressure forming a unified single product.

B. There are two basic types of laminates: (1) low pressure laminates, and (2) high pressure laminates.

1. Low pressure laminates are produced at pressures less than 400psi.

2. High pressure laminates are produced at pressures above 1,000psi.

3. In recent years a "medium pressure" laminate has been developed. These laminates are produced by pressures ranging between 400psi and 1,000psi and are sometimes referred to as reinforced plastics.

C. Resins

1. The resins used in the manufacture of high pressure laminates are of the thermosetting type. Thermosetting resins are those resins that are "set" when exposed to heat and pressure. Once having been set, an irreversible chemical reaction takes place, eliminating the possibility of returning the resin to its original character.

2. In the laminated plastic industry, two principle resins are utilized: (1) phenolic resins, and (2) melamine resins.

a) Phenolic resins are primarily used for impregnating the "base" or "core" materials.

b) Melamine resins are used to impregnate the "decorative" and "top coatings."

(1) Phenolic resins

(a) Most common phenols are derived from coal tar.

(b) The name phenol is applied to the compound having the formula C_6H_5OH, commonly known as carbolic acid.

(c) Phenolic resins are the result of a reaction of phenol and formaldehyde.

(d) Formaldehyde is a colorless gas having the formula HCHO, which is soluble in water and alcohol.

PRESS LAYUP

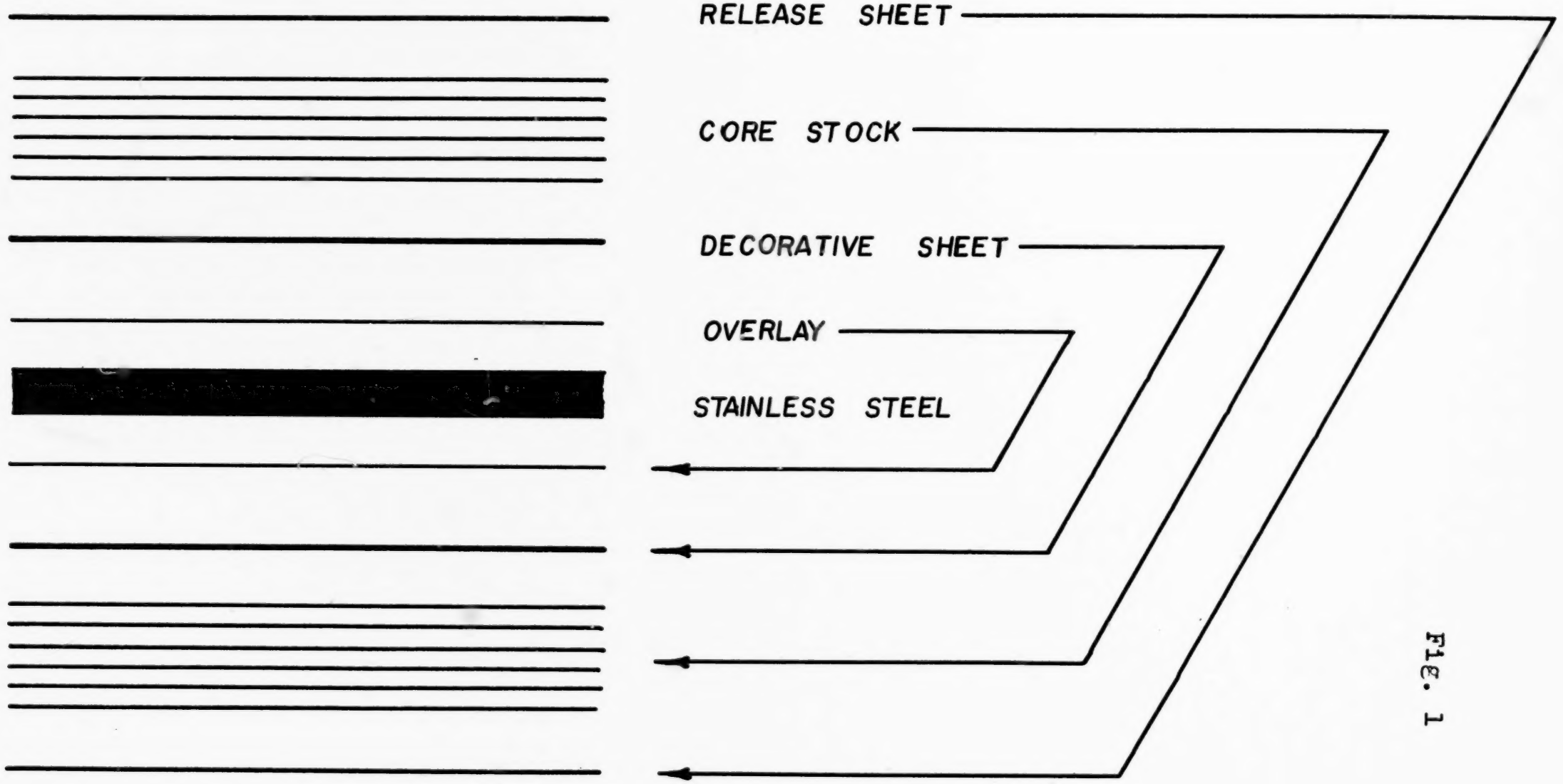


Fig. 1

(e) Phenolic resins may exist in a solid or liquid state.

(f) Most bulk storage of phenolic resin is in the form of a powder or a granular state.

(g) Phenolic resins are characterized by the following descriptions: (1) high insulation resistance; (2) high chemical resistance; (3) high water and heat resistance.

(h) The color of phenolic resins is a variable tan, ranging from black through walnut brown.

(2) Melamine resins

(a) Technically, "melamine" resins are melamine-formaldehyde resins.

(b) Melamine-formaldehyde resins belong to the family of amino resins--amino being a combining form or prefix designating chemical compounds having one or more NH_2 groups, derived from ammonia.

(c) Melamine itself is a white crystalline substance having the formula $C_3N_3 (NH_2)_3$

(d) Crystalline melamine was first isolated in 1834, and was first commercially produced in 1938.

(e) Melamine resins are used extensively as the surface resin on many plastic *laminates due to their high* resistance to abrasion, acids and alkalies. Another reason for using melamine resins as the surface resin is the clarity of the resin after it has been exposed to heat and pressure.

D. Base material

1. The "base material" or "core" of most plastic laminates is paper. There are three types of paper employed in the plastic laminate industry: (1) kraft, (2) alpha, and (3) rag paper.

a) Kraft paper

(1) The term "kraft" paper is not a trade name.

(2) The origin of the term kraft is traceable to the German word meaning strength.

(3) Kraft paper, as used in the laminate industry, is a strong, high grade wood pulp paper.

(4) Kraft papers contain 50-60 per cent air-dry fibers.

(5) Most kraft papers are dark brown to tan in color. However, kraft paper can be bleached white.

b) Alpha paper

(1) Alpha paper is produced from purified wood cellulose pulp.

(2) Alpha paper is similar in quality and appearance to the better grades of wood pulp writing papers.

(3) Alpha paper is more expensive than kraft paper.

(4) Alpha paper is used in laminates where better and more uniform appearance is required.

(5) Alpha paper is white in color.

c) Rag paper

(1) Rag paper is made of pure cotton fibers.

(2) Cotton being nearly pure cellulose, rag papers are probably the best papers.

(3) Rag papers are used to improve strength characteristics.

E. Decorative or print paper

1. The variety of decorative designs and patterns of plastic laminate is the result of printing on sheets of high quality paper.

2. Special heat and pressure sensitive inks must be employed.

3. The print paper is usually impregnated with melamine resin.

F. Overlay papers

1. Overlay papers are a high grade tissue type paper.

2. Overlay papers are usually treated with melamine resins for reasons of clarity and abrasion resistance.

3. Frequently overlay paper has impregnated within it, small metal flakes. These flakes are used to impart a speckled effect.

III. The automated production of plastic laminate* (see Figure 2)

A. The preparation of resins

1. Most manufacturers produce the necessary resins at the site where the lamination is to be fabricated.

2. Most commonly, the prepared resins are formulated in a separate building and then piped into an adjacent building where they are utilized.

3. The term "varnish" is frequently used to describe a batch of resin.

B. Impregnating core papers with phenolic resin

1. Automated equipment is employed to impregnate papers with resin.

2. The equipment used is composed of two basic units: (1) the treater, and (2) the dryer.

a) The treater. Here, large rolls of paper are fed through a series of rollers into a vat of phenolic resin.

b) The quantity of resin being applied to the paper is regulated by by metering rolls which are adjustable. The less the space between the rolls, the less the application of resin.

c) The dryer. The wet impregnated paper is directed into a series of dryers.

d) These dryers dry the impregnated resin.

e) As the treated paper is removed from the final dryer, it is cut to a standard size.

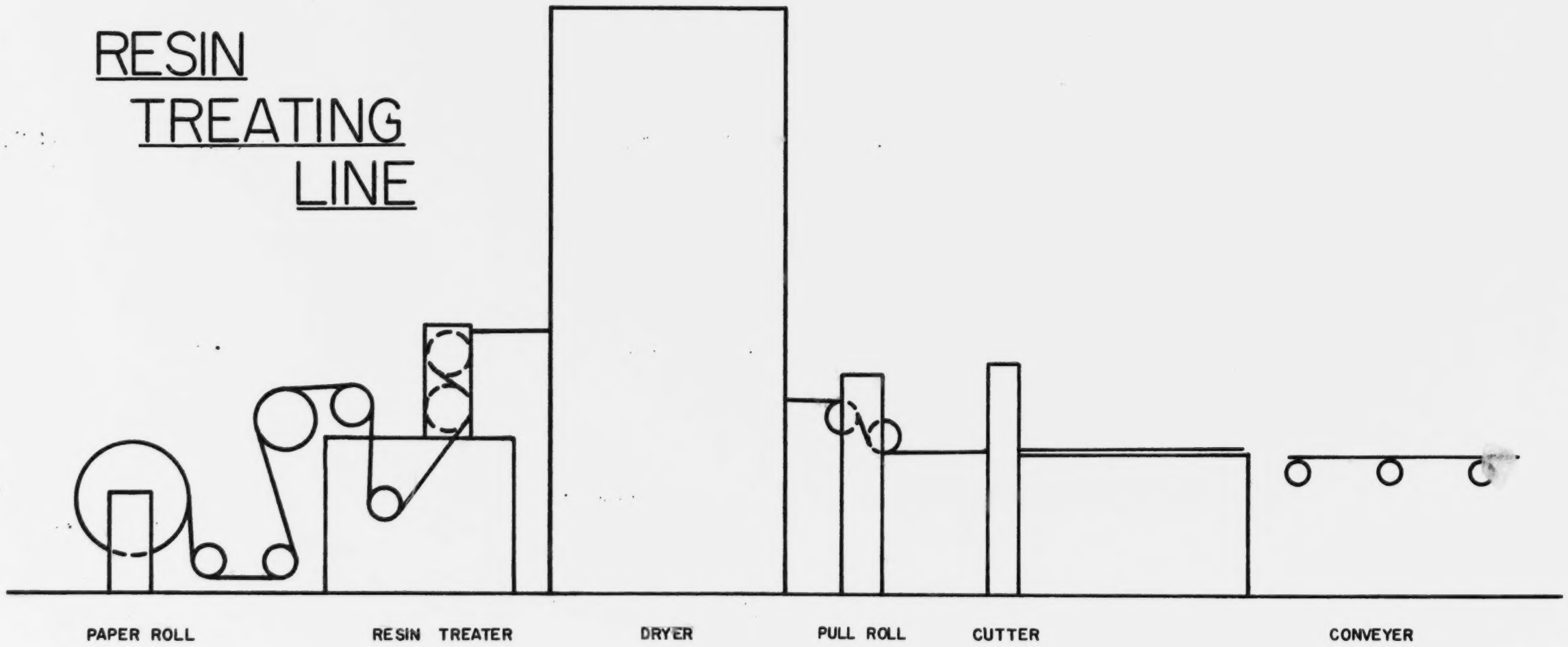
(1) This type impregnating equipment can produce from 400 to 1,000 feet of treated paper per minute.

C. Storage of impregnated core papers

1. Sized core papers, after being stacked are placed in storage rooms where the temperature is held at 80° F, and the relative humidity is held at 40 per cent.

*This description of the automated production of plastic laminate is simplified and restricted to the basic production procedures. Many special and varied procedures are employed to obtain modified results. (see Figure 3)

RESIN TREATING LINE



BASIC PRODUCTION FLOW CHART

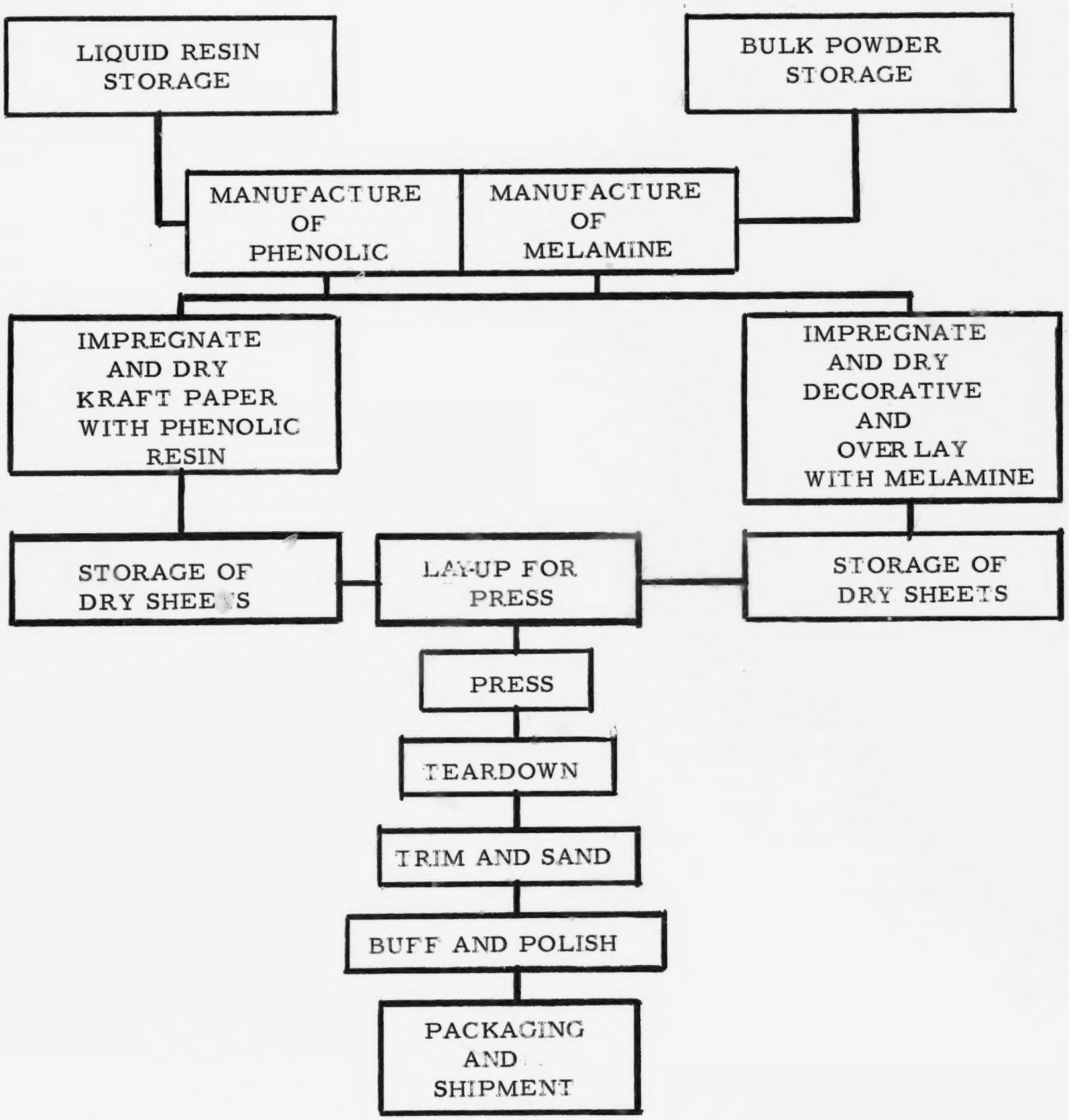


Fig. 3

D. Impregnating decorative papers with melamine

1. The treatment of the printed and colored decorative papers is almost identical to that of the treatment of core papers. The significant differences are: (1) the treating is much slower, and (2) melamine resins are used.

2. After being impregnated and dried, the decorative sheets are cut and stored at 80°F, and 20 per cent relative humidity.

E. Impregnating the tissue overlay is identical to that of the decorative papers. Melamine resins are again used.

F. The buildup

1. The assembly of core material, decorative paper and the overlay is very critical.

2. These materials are "laid-up" on micro-finished stainless steel plates by hand.

   a) These stainless steel plates are required to impart a perfectly smooth surface onto the face of the laminate.

   b) Each stainless steel plate costs about $4,000.00.

   c) For protection, the stainless steel plates are maneuvered with large suction cups.

3. The following is the lay-up sequence:

Release paper	
Core papers	One piece of laminate
Decorative paper	
Tissue overlay	
Micro-finished stainless steel	
Tissue overlay	
Decorative paper	
Core papers	One piece of laminate
Release paper	

G. Pressing the buildup

1. The laid-up materials and the stainless steel plate are conveyed into a large hydraulic press with heated platens.

2. The lamination is pressed at about 350°F for about one hour at a pressure exceeding 1,600psi.

3. The capacity of an average press is about 260 sheets measuring 5' X 12' per hour.

H. Cutting the laminated sheet to size

1. After removal from the press, the laminated material is automatically cut to size with double-trim saws.

2. The flash is first removed along the long edges. The sheet is automatically turned 90° and then trimmed to finished length with double-trim saws.

I. Sanding the laminate to finished thickness

1. The back side of the laminate is passed over a drum sander and cut to finished thickness.

2. This sanding operation also prepares the back of the laminate for gluing by texturing the back surface.

3. Most laminates have a thickness tolerance or plus or minus .004 inch.

J. The face of the laminate is polished with a very long buffing wheel with a pumice and water abrasive solution.

K. Packaging and shipping.

1. The finished laminate is inspected, wrapped and shipped.

2. Most laminate is shipped flat.

IV. Grading plastic laminates.

A. Explicit engineering-type data is available for detailed grading of plastic laminates (see Duffin, Chapter 5).

B. A more practical understanding of grading can be derived by analyzing the standardized grades as manufactured by a leading producer. The following information was obtained from Westinghouse Electric Corporation.

Grades	Applications	Technical Data
1/16" General Purpose. Thickness tolerance: ± .005"	Most widely used type. For any vertical or horizontal use requiring tough, long-wearing qualities, such as counters, tables, sink and counter tops, furniture, bars, desk tops, vanities, flush doors, wainscoting, etc.	For lamination by fabricators having the necessary bonding equipment. Supplied oversize in length and width. Should be glued to flat, solid surface, usually plywood, Novoply, or other flat surface which will take an adhesive. Urea resin glues are usually used in conjunction with a plate press or hand clamps. Cold press facilities assure most satisfactory bonding job.
.050" Post-forming Thickness tolerance: ± .003"	For use where inside or outside radii are required, such as sink and counter tops, fully formed tops, contoured tops, bar rails, store counters, restaurant tables, etc. Can be custom-formed for a wide variety of uses.	Should be bonded to a solid base such as plywood, Novoply, or other smooth surface. Can be formed to inside radii as small as 3/16" under suitable temperatures, using specially designed equipment. Minimum radius of outside bend, most grades 3/4". Available in all patterns or solid colors. Recommended forming temperature 315-325°F Heating time depends upon type of heat source, but should reach 315°F within 60 seconds.

1/32" Grade, Thickness tolerance: ± .003"	For furniture, cabinet, and other vertical applications. Also where material is required that can be postformed to a small radius. Minimum outside design radius is 3/8". Recommended for edge-banding.	Surface properties similar to .050" Postforming grade. Recommended forming temperature, 315-325°F. Heating time depends on heat source, but should reach 315°F within 60 seconds.
Fire Resistant Micarta .050" Thickness Tolerance: ± .003	Fire Resistant Micarta carries the Underwriters' Laboratories, Inc. label and meets rigid standards wherever fire resistance is a factor such as public guildings, buses, railroad cars, and ships.	The Underwriters' Laboratories, Inc., established fire hazard rating of this product when bonded to a representative incombustible core (3/4" Marinite-36 or cement asbestos board) is: Flame Spread 15; Fuel Contributed 10; Smoke Developed 5.
1/16" Cigaretteproof. Thickness tolerance: ± .005"	This grade is guaranteed to withstand lighted cigars and cigarettes. Used for table, counter, bar tops, etc.	Made in the same way as General Purpose 1/16" Micarta except for an inner ply of aluminum in the buildup which dissipates heat applied to the surface. Meets military standards Mil-T-17171B (ships) Type II. Resistance to High Temperatures and Cigarette Burns, which involves heating a spot on the surface to 550°F for 10 minutes without blistering.

General Purpose, good one or two sides, 3/32", 1/8", 1/10", 5/32", 1/4". Thickness tolerances: 1/8" = ± .008" "3/32", 5/32", 1/4" = ± .010	For interior paneling of buses, trains, ships, and wall partitions. The 1/8" material is commonly used for kick plates on doors. If minimum warpage is required, the good two sides material is recommended.	Solid laminate throughout; either good two sides or good one side with balanced construction.
5/32" Micarta-board. Thickness tolerance: ± .008"	For furniture, wallboards, panels, walls, partitions, and other vertical applications.	Recommended for use where it can be glued down to frame or core by cold or hot press.
Backing sheets, .062", .045", and .031", .020" thick ± .005"	For backing on underside of core panel to increase stability and resistance to moisture.	Recommended for use with any construction.
Aluminum Micarta, 1040", .098" ± .005"	For heavy-duty applications, panels for car wash equipment, industrial storage, walls and ceilings in buses, railroad cars, ships.	Micarta surface bonded to aluminum core with a special adhesive. Plastic-to-metal bond is made simultaneously with curing of the Micarta.
Micarta Wall Paneling, .550"	For walls in restaurants, churches, schools, playrooms, wainscoting.	Furnished in 16" x 96" and 16" x 120" tongue and grooved panels. 050" Micarta face is factory bonded to .50" Homasote core with backing sheet. Flame Spread of 150.

.025" Microform Micarta. Thickness tolerance: ± .003"	For furniture, kitchen cabinets, picture and door framing, and other vertical applications requiring ultra-small radii. Minimum outside design radius is 3/16". Recommended for edge banding.	Minimum radius when forming hot, inside 1/8". Surface properties similar to .050" Postforming grade. Recommended forming temperature, 315-325°F. Heating time depends on heat source, but should reach 315°F within a maximum of 60 seconds, preferably 22 to 27 seconds.
1/8" Doublewear Micarta. Thickness tolerance: ± .004".	For flooring in computer rooms, clean rooms, and other raised flooring applications.	Furnished in 24" x 24" squares. Slipperiness coefficient (James Testing Machine) is 0.70 and impact resistance (NEMALD-1-1964) of better than 30 inches.

V. Standard sized sheets of plastic laminate.

A. Almost any practical size sheets of plastic laminate can be fabricated. The following are the basic size dimensions that are commonly manufactured:

Width in inches: 24; 30; 36; 48; 60.
Length in inches: 60; 72; 84; 96; 120; 144.

VI. Laminate finishes (surface characteristics).

A. Much variation is evident in the labeling of the characteristics of surface qualities of various laminates as manufactured by the various manufacturers. One manufacturer, Westinghouse Electric, identifies and characterizes Micarta laminates as follows:

1. Oil Rub Finish has the craftsmanlike surface obtained by hand rubbing fine wood, yet it wears like the mar-resistant laminate it is. Realistic wood grain appearance obtained by application of furniture polish or oil. Will have a gloss reading of 2-5.

2. Lo-Glare Finish textured low light-reflection surface that enhances the beauty of the wood grain. Will have a gloss reading of 4-10.

3. Velvet Finish most recently developed finish which falls between Lo-Glare and Satin in reflection. Excellent for furniture and walls. Will have a gloss reading of 7-14.

4. Satin Finish most popular of laminate finishes. Suitable for any application. Will have a gloss reading of 15-34.

5. Gloss Finish mirrorlike surface for special applications where high gloss is required. Will have a gloss reading of 80-100.

6. Furniture Finish slightly higher gloss than satin finish for special applications. Will have a gloss reading of 36-55.

GLOSSARY OF BASIC LAMINATED PLASTIC TERMS

Cure To change the physical properties of a material by chemical reaction (polymerization, condensation, or vulcanization) usually accomplished by the action of heat and/or pressure.

Delaminate To split a laminated plastic material along the plane of its layers.

Delamination The separation of a laminate into layers due to failure of adhesion of the binder or the failure of cohesion of the filler.

Dimensional Stability Ability of a plastic part to retain the precise shape in which it was molded or fabricated.

Dull Finish A nonreflecting molded finish.

Flash The material which is forced out of a mold or press at the time of closing. Fin and flash are interchangeable with each other.

High-Pressure Laminate Laminates molded and cured a pressure not less than 1000 psi and more commonly in the range of 1200 to 2000 psi.

Laminate A product made by bonding together two or more layers of material or materials.

Laminate Base The fibrous sheet material, which, after impregnation with resin, is consolidated into the finished product. The physical characteristics are largely due to the type material used.

Laminated Plastic A dense, tough, solid produced by bonding together layers of fibrous sheet materials impregnated with a resin and consolidated by simultaneous application of heat and pressure.

Laminating The process of producing a laminate.

Lamination Any layer in a laminate. Also the process of producing a laminate.

Low-Pressure Laminate Laminates molded and cured in the pressure range of 25 to 400 psi.

Mirror Finish A uniform high gloss sheet finish free from lines or brush marks. Also known as "high gloss finish."

Moisture Resistance The ability of a material to resist absorbing moisture from the air or when immersed in water.

Paper A thin fibrous sheet material produced from cotton, wood pulp, asbestos and other fibers, using the established paper-making processes.

Phenolic A general term for phenol-formaldehyde resins.

Postforming The shaping of cured laminate sheets by the rapid application of heat followed by forming over a mold by the application of pressure.

Relative Humidity Ratio of the quantity of water vapor present in the air at a given temperature to the quantity which would saturate it at the same temperature.

Resin A solid, semi-solid, or pseudo-solid organic material which has an indefinite and often high molecular weight; exhibits a tendency to flow when subjected to stress; usually has a softening or melting range and usually fractures conchoidally.

Sanded A finish produced by a sanding operation. This operation is generally performed to meet the close thickness tolerance requirements of plastic laminates.

Semi-Gloss Finish The most common sheet finish which has fine parallel brush lines running lengthwise to the sheet. Also, medium gloss.

Thermoplastic A plastic which softens upon the application of heat and rehardens upon cooling. It can be softened and hardened repeatedly.

Thermosetting Plastic A plastic which has undergone a chemical change upon the application of heat and which does not appreciably soften or deform if later reheated.

Water Absorption The ratio of the weight of water absorbed by a material to the weight of the dry material.

BIBLIOGRAPHY

Brown, D. Warburton, and Harris, Wilbur T. An Introduction to Engineering Plastics. New York, New York: Murray Hill Books, Inc., 1947.

D'Alelio, G.G. A Laboratory Manual of Plastics and Synthetic Resins. New York, New York: John Wiley and Sons, Inc., 1942.

DuBois, J.H. Plastics. Chicago, Illinois: American Technical Society, 1945.

Duffin, D.J. and Nerzig, Charles. Laminated Plastics. New York, New York: Reinhold Publishing Corp., 1958.

Hammond, James J. et al. Woodworking Technology. Bloomington, Illinois: McKnight & McKnight Publishing Co., 1966.

Capron, J. Hugh. Wood Laminating. Bloomington, Illinois: McKnight & McKnight Publishing Co., 1965.

O'Neill, James M. Fabricating with Formica. Milwaukee, Wisconsin: The Bruce Publishing Co., 1958.

Simonds, Herbert R. Source Book of the New Plastics. New York, New York: Reinhold Publishing Co., 1961.

Simonds, Herbert R. A Concise Guide to Plastics. New York, New York: Reinhold Publishing Co., 1963.

Society of the Plastics Industry. Plastics Engineering Handbook. New York, New York: Reinhold Publishing Co., 1960.

Swanson, Robert S. Plastics Technology. Bloomington, Illinois: McKnight & McKnight Publishing Co., 1965.

Formica Corporation. A Division of American Cyanamid. Cincinnati, Ohio.

Westinghouse Electric Corporation, Micarta Division. Hampton, South Carolina.

UNIT I I

VINYLWOOD VENEERS

I. Vinylwood veneers are matural wood veneers impregnated with the many vinyl polmers or copolmers, producing a finished product with all of the original wood characteristics.

A. Another process surfaces the veneer with the same type of plastic resin making a firmly bonded film over the entire face of the veneer. Both methods subject the veneer to heat and pressure.

B. This "marriage" of plastic and wood veneer is a relatively new product having been introduced to industry within the last three years.

1. Industry has a great respect for this new product with a ready market.

2. Many companies, especially furniture manufacturers, are building entirely new plants or adding facilities to handle production of this new product.

C. On August 3, 1965, the President of Drexel Furniture Company announced at a conference in San Francisco that his company was embarking on a new concept in automated furniture manufacturing.

1. Less than three months later at the Southern Furniture Markets, Drexel introduced a new line of furniture made by wrapping a unique vinyl coated wood veneer around a core material.

2. Drexel is now experiencing wide success in this new market concept. (See next page.)

I I. Vinylwood veneer is a very versitile material that can be applied to almost any type of core, or marketed seperately in any requested or convenient size.

A. The veneer is produced with an aluminum foil back-up sheet which is one and one half mils thick.

1. This aluminum foil acts as a moisture and heat barrier and also facilitates the bending and forming around corners.

2. The aluminum foil also permits small members like legs, posts, and rails to be covered on all sides.

B. The aluminum foil backed veneer can be applied to any appropriate solid surface.

1. For the furniture, it is applied to present cores of solid wood, plywood, particle board, hard board, and flake board.

2. For the building trade market, it can be bonded directly to walls, wall panels, and may be placed on a core material for use on floors.

C. The characteristics of the wood veneer are changed in the manufacturing process, making vinylwood veneer a product in strong demand.

1. The impregnation and vinyl resins make the wood much harder than ordinary wood veneer.

2. The grain of the wood is made to stand out making its appearance more pleasing.

D. Vinylwood veneers are manufactured from many species of woods. At the present time, more hardwoods than softwoods are being used in its manufacture.

III. Many consumers and industries are seeking vinylwood veneer for many varied purposes. To meet demands, producers are supplying it in any form.

A. The aluminum foil backed veneer is offered in standard furniture sizes on a cut-to-size basis, or in sheets 42" wide and 82" long.

1. Furniture makers usually do their own bonding to a core material to fit their personal demands.

2. Some consumers purchase the sheet stock and install it directly to an appropriate surface.

B. At present, furniture makers are the greatest consumers of vinylwood veneers, although the building industry and other manufacturers are finding more and more uses for it.

1. Furniture makers are beginning to turn out full lines of domestic, commercial, and institutional furniture with vinylwood veneers.

2. The building industry is finding it indispensible for wall panels, moldings, base boards, window sills, floors, and other types of trim.

3. Other users include automobile and maritime manufacturers.

IV. The many superior factors of vinylwood have made it a product that other industries envy, although it does have limitations, about which research is being done.

A. The need for any liquid finishes is completely eliminated.

1. It can be cleaned by wiping with a dry or damp cloth.

2. Conventional household waxes and polishes can be used.

B. Vinylwood veneer is resistant to most common abuses.

1. It is very resistant to cigarette burns.

2. It is not harmed by most household stains and chemicals.

3. Scratches can be sandpapered and rewaxed with effective results.

C. Working with vinylwood veneers is relatively simple and easy.

1. Installation can be done with any good contact cement.

2. Very little pressure is needed for small jobs. Hand pressure can be employed.

3. Large jobs require only a cold press.

4. Certain core materials require the use of crossbands, to eliminate telegraphing.

D. Expensive and authentic looking furniture is produced at a considerably lower cost.

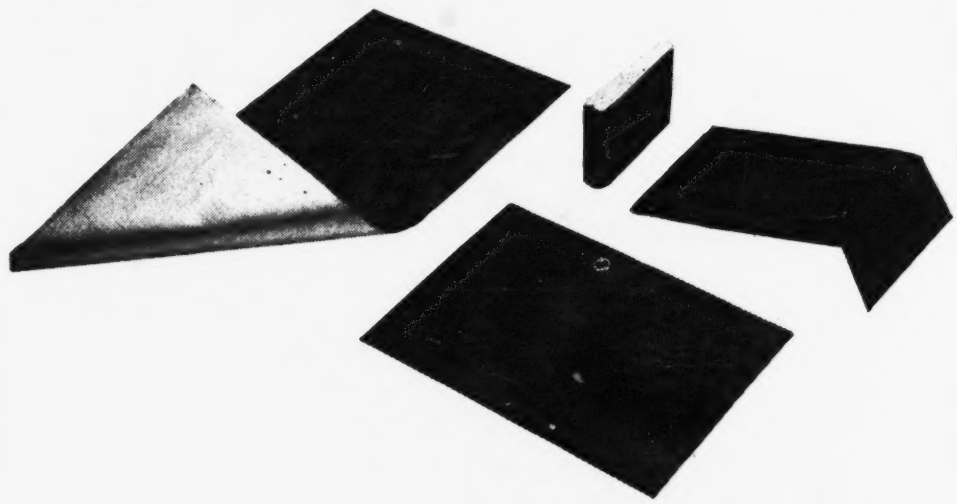
1. Cost reductions of 15% have been recorded.

2. The process of manufacture also enhances the beauty and value of lower cost woods.

E. Vinylwood does have some limitations on which the producers are constantly doing research.

1. It is presently adaptable to only certain modules of furniture.

2. The rigidity of the material prevents perfect forming on some curves and bends.



About Furnaflex Veneer

Above are sample sheets of Furnaflex, a real wood veneer which contributed to a new concept in furniture making, introduced by Drexel in its Modulus group last fall. Note sheet on left shows aluminum foil backing which gives the material heat resistance plus dimensional stability. Center shows material wrapped around four sides of a poplar rail. Right indicates how it may be wrapped around a 3/16-in. radius. Also pictured is a sample of cherry.

Furnaflex is a genuine hardwood veneer, 1/85 in. thick, surfaced with a 6-mil clear polyvinyl chloride film and backed with aluminum foil. Vinyl film is the same as used by leading flooring manufacturers and is resistant to all common acids and household chemicals. Aluminum foil is 1½ mils thick. The three layers are permanently bonded into an extremely flexible laminate. The veneer can be stained before lamination to match any color; distressing and antiquing are also possible. According to the manu- "competitive to all high pressure laminates."
"competitive to ll high pressure laminates."

Heretofore Furnaflex has been used by Chris Craft, U.S. Navy ships, Sears catalog sales, Buick Riviera, Piper aircraft, plus extensive use on walls and floors.

It was tested for physical properties by United States Testing Co. (Report No. 45679, Aug. 4, 1958), and showed no adverse effects to high temperature exposure, temperature change, or salt spray atmosphere. It effectively resisted all common household agents; only dye was able to inflict a permanent stain.

Sample of Furnaflex and pre-finished plywood were each tested on a a Tabor abrasion machine, using 1,000-gram weights and ½-in. Behr-Manning 5/0-180A Adalox finishing sandpaper. Average number of cycles to wear through the coating on prefinished plywood was 25; Furnaflex was 2100.

UNIT III

VINYL WRAPPED WOOD SUBSTITUTES

I. There are many products covered with vinyl polmers or co-polmers but only those imitating wood characteristics will be considered in the outline as vinyl wrapped wood substitutes.

A. There are so many vinyls produced today that it is impossible to list all of the trade names. A few of the vinyl resins are:

1. Butacite by DuPont

2. Geon by Goodrich

3. Krene by Union Carbide

4. Lemoc by Borden

5. Opulon by Monsanto

6. Plyovan by Goodyear

7. Saran by Dow Chemical

B. Vinyl resins are thermoplastic in nature and will burn, but have self-extinguishing qualities. Temperatures above 150°F. for any length of time will cause damage.

C. The grain of any wood can be imitiated, creating a wide choice of patterns for consumers.

1. Patterns of wood grains are duplicated actually through a photographic process.

2. Practically all of the visible wood characteristics are retained.

D. Vinyl resins are produced from heating coke and lime producing calcium carbide.

1. Acetylene is made from water and calcium carbide which is added to acetic acid to produce some of the vinyl polmers.

E. These resins are produced in liquid form through the carefully formulated chemical processes already mentioned.

1. These resins are convertied to films of various thickness by other industrial processes.

2. The limitations of these products have no limits according to reports coming from the procedures.

I I. The application and processing of vinyl resins involves intricate industrial processes and are received by the consumer in some form of finished product.

A. The greatest users of vinyl wrapped wood substitutes are the building industries, the furniture industries.

1. The building industry uses the material mostly in covering various types of cores for wall panels.

2. The furniture industry likewise uses it to cover different types of cores for making many types of furniture for domestic and industrial furniture.

3. Radio and television cabinets made of cores of metal, plywood, and hardboard are made to look like wood with vinyl wrapped wood substitutes.

B. Domestic users may purchase the product in roll form and apply as wallpaper, or in self-adhesive rolls for many other purposes.

C. Other uses of vinyl wrapped wood substitutes are toy makers, auto manufacturers, luggage makers, etc.

I I I. Resins made from vinyl polmers and co-polmers are applied to various industrial products which makes a very wide market that consumers are inspired to purchase.

A. Vinyl wrapped products look very pleasing and authentic with long wearing qualities. These products look so authentic that they are no longer accepted as second rate products.

B. Vinyl wrapped products are much cheaper than similar real wood counterparts.

C. The products are decorative with color retention qualities beyond that of many conventional wood finishes.

D. There are no checking, peeling and other defects usually associated with natural wood finishes.

E. The surface of vinyl wrapped wood is tough, scuff proof and stain resistant.

F. Like all other good products, vinyl wrapped wood substitutes do have short comings.

1. They lack depth perception which distinguishes them from real wood. This is somewhat corrected by fine embossed ridges.

2. They are lacking in good thermal control. The kindling point is relatively low, although there are self-extinguishing features.

3. The surface can be stained by black shoe polish and dyes.

4. The final finish lacks depth perception.

About Drexel's Modulus Group

Above is one of several room arrangements possible with Modulus, a new group of furniture by Drexel . . . the first to be made by a wrap-around laminating process described in article beginning on page 56. Note plastic caps on bed posts; hardware on corners of case pieces.

Drexel advertising says, "This is Modulus . . . so new, so different, there's no other furniture manufactured like it . . . anywhere! Because of new production methods that lend themselves to this design, significant economies result. Drexel is passing these savings on to you, which helps make Modulus an exceptional value."

Hang tags on the furniture tell that the surface is worry-free regarding household products, nail polish, perfume, scratches or burns. "Crayon marks wipe off, water and alcohol rings are unheard of. not even a burning cigarette can harm it."

Yet the veneer surface is real wood.

Instructions for care of Modulus are: "To remove soil, wash with a clean cloth saturated with a mild household detergent solution. Wipe off immediately with a cloth soaked in clean, warm water and dry thoroughly."

The furniture is being promoted for "the young set, from junior high to junior executive." By using appropriate accessories with Modulus, a room can be right for a sports-minded young man . . . or with a frilly bedspread and a piece or two of rattan accent pieces (also in the group), the room can be very feminine. There are storage pieces equally at home in the living room as the bedroom.

The surface which Drexel calls Armorwood, is made of a unique wood veneer product, Furnaflex, manufactured by Wilcox-Woolford Corp., Spring City, Pa.

BIBLIOGRAPHY

Modern Plastics Encyclopedia, McGraw Hill Inc. New York, N.Y., 1968.

Cherry, Ramond. General Plastics, Bloomington, Ill: McKnight and McKnight Publishing Co., 1967.

Swanson, Robert S. Plastics Technology. McKnight and McKnight Publishing Co., 1965.

Furniture Design & Manufacturing. Chicago, Ill. August, 1966. Vol. 38, No. 8. pp. 56-62.

Wood-Mosaic Corporation. Louisville, Kentucky. Phamphlet and letter. April 8, 1968.

UNIT III

WOOD GRAIN REPRODUCTION ON WOOD AND OTHER MATERIALS

I. The reproduction of wood grain on a variety of materials meets a need.

A. Aesthetic

1. Grain

a) Can be controlled

(1) Direction

(2) Patterns

(3) Matching arrangements in simulated veneers

(4) Coloring

(5) Shading

(6) Tactile qualities

b) Can be transferred to practically any material having a relatively smooth dense surface.

(1) Wood

(2) Metal

(3) Particle board

(4) Hardboard

(5) Paper

c) Printed materials can be combined with other materials for special qualities.

(1) High pressure laminates

(2) Vinyls

II. Methods used in simulating wood grain

A. Hand

1. Base color with contrasting overlay in the pattern of wood grain.

a) Articles displayed in museums indicate man's activities in this area date back many centuries.

b) Still acceptable technique when the time factor is not critical.

(1) Requires high degree of skill if the craftsman is to approach the quality of commercial work.

(2) Availability of improved glazes and other materials has encouraged the efforts of the home craftsman.

2. Wood graining kits have been a popular craft item over the past few years.

B. Machine

1. Gravure printing accounts for practically all of the work produced commercially.

a) Developed in Europe and America through the early part of this century.

b) Greatest advancement followed World War II.

(1) Improvement in inks

(2) Availability of quality substrates

(3) Development of precision equipment

(4) Development of new finishes

(5) A ready market for simulated wood grain products

2. The rotogravure technique is the most commonly employed medium in mass production printing.

a) Can be done with speed and consistent quality

b) Will respond to and hold precise adjustments

c) Can incorporate a variety of shades and colors

d) Versatility in exterior and interior design

(1) Residential

(2) Business

(3) Commercial

(4) Industrial

B. Economy

1. While the use of certain domestic hardwoods is becoming prohibitively expensive simulated wood products are receiving broader application and greater popularity.

a) Exotic veneer patterns in furniture construction

b) Simulated hardwood in automobile interiors and body finishes

c) Extensive use in paneling and interior decoration

d) Greater representation in counter topping and other areas associated with high pressure laminates.

e) Continuous growth corresponding with the expansion of the building industry.

2. As hardwoods become more scarce, their cost will increase.

a) Conversely automation and mass production hold costs to a competitive level in areas representing simulated wood products and wood grain finishes.

b) The popularity of products competing with articles made of the expensive hardwoods is increasing at an accelerated rate.

c) The public has been educated to the value and economy of simulated products.

III. Rotogravure Printing

A. Equipment

1. Gravure cylinder

a) Made of copper

b) Commercial sizes generally 2 ft. to 4 ft. wide

c) Most important, delicate and costly adjunct to grain reproduction process

d) Slow, precise and time consuming hand work to perfect the pattern etched in the copper cylinder with acid.

e) The desire for multi-color printing has increased the complexity of rotogravure printing.

2. Making the cylinder

a) First a copy of the wood grain to be printed is made considering the finest details of grain patterns and background colors.

b) The copy is then photographed by a camera.

c) From these negatives the pattern or grain is retouched to fit the circumference of the cylinder, both in detail and color wise.

d) From the retouched negative, a first phase positive is made and again it is corrected and retouched.

e) After this step, a copy of the negative is made, and from this negative back again to the final positive which is used to engrave the cylinder.

f) The final positive is exposed onto a light sensitive gelatin (paper backed) and this in turn is transferred to the copper plated cylinder.

g) The gelatin picks up the reverse image from the positive in various densities, and these densities give a base for the etching which is done with ferric chloride.

3. Testing the cylinder

a) After the cylinder has been etched, it is proofed.

(1) Defects and color changes are determined and corrected by hand work.

(2) After corrections, a final proof is printed and one copy is sent to the customer and another placed on permanent file as a guide to match future remakes.

b) A final step entails coating the cylinder with a very thin layer of hard chrome to improve its resistance to wear.

B. Other Components and Accessories

1. Application roller

a) Wood grain pattern is transferred to this roller from the etched cylinder.

b) Application roller is made of synthetic elastomers or gelatin - a soft rubber lide composition.

c) Print transferred from the gravure cylinder to the application roller is in turn transferred to the surface of the work being processed.

2. Doctor blades

a) These blades ocillate back and forth as they scrape all excess ink off the rollers.

b) One doctor blade is required for the gravure cylinder and one is required for the application roller.

c) Two sets of blades are required in order that they may be ground and honed, perhaps as much as four times a day. This is essential for quality work and the protection of the gravure cylinder.

3. Inks

a) Two types

(1) Lacquer

(2) Synthetic

b) Each formulated to do a specific job depending upon the substrate, speed of drying, subsequent handling and finishes to be applied.

4. Base coat

a) Basic face color

b) Contrast for grain pattern

5. Sealers and top coats

a) Selected and applied in keeping with the characteristics of the material being processed.

(1) Metal generally has one or two coats of clear synthetic baking material that top coats directly over the inked grain.

(2) Wood furniture and paneling products may employ a coat of sealer and one of two coats of nitrocellulose lacquer.

(3) An alternate finish used with wood products may be one coat of catalyzed alkyd urea resin base clear material.

b) Printing done directly on particle or flake board

(1) Synthetic fillers are used

(2) Without proper attention to filling and sealing, the chip patterns will migrate through the base coat and distort the grain pattern.

C. Machine adjustment for shapes, sizes and surfaces.

1. Components of the machine are arranged to meet specific requirements.

a) Horizontal and vertical printing

b) Printing on cabinet work consisting of flat surfaces with no overhang.

2. Special set-ups for such work as tapered legs.

D. Maintenance

1. Critical to the quality of the printing desired.

2. Protection of the gravure roller from undue and excessive wear is of primary concern.

3. Proper use of the equipment and strict cleaning schedules receive emphasis.

I V. Statue of wood grain reproduction

A. Increasing demand

1. Population growth

2. Accelerated construction increasing yearly

3. Quality products effectively meeting diverse requirements

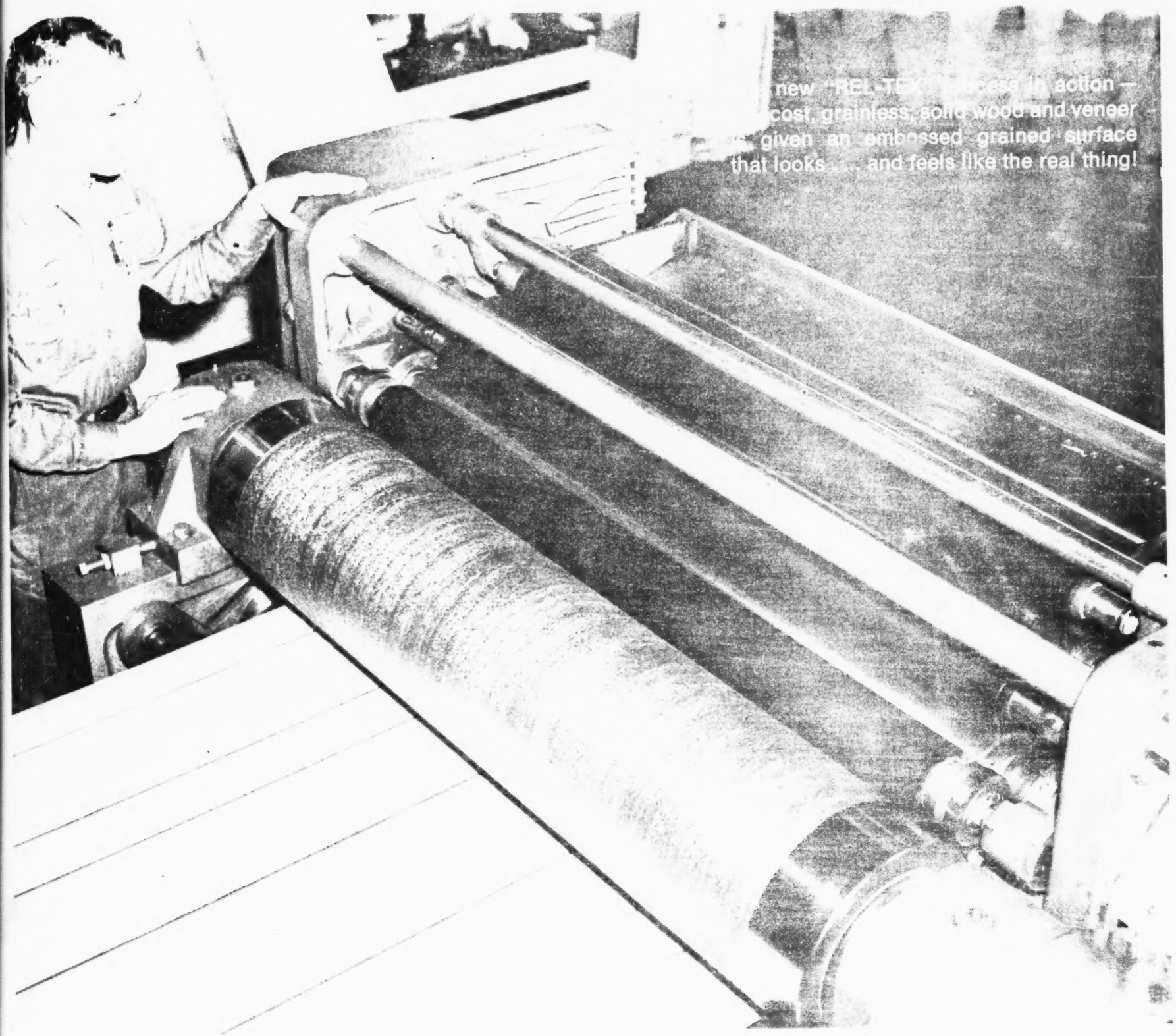
B. In a strong position to compete with other products

1. Automation and mass production

2. Wide range of materials lending themselves to the process

3. Growing markets

4. Excellent competitive potential


new "REL-TEX" process in action —
cost, grainless, solid wood and veneer
given an embossed grained surface
that looks . . . and feels like the real thing!

"REL-TEX". . . a new Reliance process upgrades low-cost solid woods, veneer, hardboard and particleboard . . . gives them a beautiful "real grain" surface!

Take panels or furniture parts of woods like gum, southern pine, alder, or cottonwood, and automatically feed them through the new "REL-TEX" process set up to simulate one of the traditional and higher cost woods or face veneers, like pecan, walnut, mahogany, or oak . . . you name it. The result is an amazing and highly attractive grained and embossed surface that most experts would find near impossible to distinguish from the real thing.

While primarily developed to upgrade and beautify inexpensive non-grain woods, this ultra new "grain-and-stain" process can also be used to provide a most realistic 3-dimensional grained surface on hardboard and particleboard. The key to the "REL-TEX" process is special grain-embossing cylinders and machine developed through joint efforts of Reliance and equipment manufacturers.

Etched with specially hardened debossing lands, each cylinder is capable of grain embossing at a high rate of production, at a very minimum cost. "REL-TEX" embossing cylinders and decorator-styled finishes can be duplicated in pecan, walnut, mahogany and oak—just about every type of wood grain surface can be reproduced.

For more complete information, contact Reliance, Dept. CMA, Louisville, Ky.

Reliance Universal Inc.
Louisville, Kentucky
Reliance Universal Inc.
High Point, N. C.
Reliance Universal Inc.
Irvington, N. J.
Southern Varnish Co.
Roanoke, Va.
Reliance Universal Inc.
Salem, Oregon
Reliance Universal Inc.
Houston, Texas
Reliance Universal Inc.
North Chicago, Ill.
Reliance Universal Inc.
Los Angeles, Calif.
Reliance Universal Inc.
Daveluyville, Quebec, Canada

Reliance

GLOSSARY

1. Alkyd - A type of synthetic resin usually the reaction product of heat, a vegetable oil, phthalic anhydride, glycerine and solvents. By varying the components, a wide range of characteristics are obtainable.

2. Base coat - The pigmented coating which produces the background color (usually lighter) of the wood grain. Ink is then applied over the basecoat. Also called ground coat, particularly in wall paneling industries.

3. Doctor Blade - A flexible (usually steel) blade used to scrape excess material off a surface. In a graining machine, doctor blades scrape excess ink off both the engraved cylinder and the transfer roll.

4. Glaze - Usually a pigmented stain which is applied over a previously stained or filled surface to subdue the original color without obscuring it. As a gravure term, a glazing cylinder that prints a design, similar to a brushed copper effect, which is used to add character to non-grain woods, or else add additional color.

5. Gravure - A printing method, wherein ink is deposited in depressions of a roller and then applied to the surface to be printed. Since the depressions can be made in varying depths, more or less ink can be deposited, thus giving excellent tonal ranges.

6. Nitrocellulose - Chemical term for one of the binding materials used in lacquers, nitrated cotton, and often called "cotton."

7. Rotogravure - The gravure process in a continuous mechanism using cylinders rather than flat plates.

8. Synthetic - A compound or resin other than one found in nature (such as rosin) but which is produced by a chemical process. Also, a term used for a finish employing such resins.

9. Particle Board - A compostiion board made from wood particles, bound together with a resin, and pressed, with heat, into a board.

10. Elastomer - A resinous compound which gives permanent elongation to a coating material or which gives a flexibility to a film or to a molded object.

11. Hardboard - A composition board made by reducing wood to individual fibers, and then pressing the fibers into a board under heat. In wet process board, the actual lignin of the wood is the binder, while in in dry process board, a resin must be added.

BIBLIOGRAPHY

The Bellewood Story, Reliance Universal Inc., Louisville, Ky.

Furniture Design & Manufacturing, December, 1965. Vol. 37, No. 12. Published monthly by Graphic Arts Publishing Co., 7373 North Lincoln Avenue, Chicago, Illinois 60646.

Furniture Design & Manufacturing, February, 1966. Vol.38, No. 2.

Furniture Design & Manufacturing, April, 1966. Vol. 38, No. 4.

The Rel-Var Story, Reliance Universal Inc., Louisville, Ky.

Woodgraining on a Modern Production Line, Reliance Universal Inc., Louisville, Ky.

Useful Facts and Figures, 2nd Edition, Reliance Universal Inc., Louisville, Ky.

UNIT IV

HIGH PRESSURE MOLDED PRODUCTS AND OTHERS

I. Thermoplastics and thermosetting plastics may be molded into definite furniture component shapes and other wood products. This is rather a new and enlightening concept of the 1960's with predictions to phase out conventional concepts of some of the wood industry in the 1970's.

A. The form and shapes of the present products are as follows:

1. Knobs for drawers

2. Decorative applied carvings

3. Fret work

4. Frames and panels

5. Legs

6. Form chairs

7. Picture frames

B. Some of the common problems of the new products have similarities to lumber products and some special problems unique to the new element.

1. Effects of temperature vary in plastics.

2. Finishing procedures are not homogenous to wood.

3. Adhesives require special considerations on plastic products as well as wood.

4. Fasteners are a different concept.

5. Workability and machining practices vary .

C. Molding Techniques

1. Injection Molding

a) In the process of injection molding thermoplastics are the material used in the form of small pellets.

b) Pellets are fed into the machine via a hopper arrangement. The pellets are plasticized by heating and then injected under pressure into a cold mold where it sets and is ejected from the machine.

2. Compression molding is the most common approach for thermosetting materials. The plastic sheet material is squeezed into a desired shape by application of heat and pressure to the material in a mold.

3. Extrusion Forming

a) Dry plastic is fed into a long heating chamber and is moved by an auger that forces out the material through a die having the desired shape.

I I. High Impact Polystyrene Wood Components reached a stage of high development in the middle 1960's which has introduced a new form of matching the beauty of natural woods into furniture components. There is now a current surge in the major furniture industries to develop this man-made product.

A. Polystyrene is a man-made thermoplastic that is lighter in weight than most woods and has several distinct advantages.

1. A housewife now can move with ease some of the previous wood furniture products that were heavy and bulky.

2. There is no shrinkage and loosening of joints in dry winter conditions, no swelling to cause doors to stick.

3. Polystyrene is impervious to attack by rot formations.

4. Manufactures of this product advocate that experienced cabinet makers find it difficult to distinguish it from real wood.

a) Wood grain is copied in the molds.

b) Wood grain is photo engraved.

c) Wipe graining is used on complex parts.

B. Labor costs on large polystyrene productions are lower.

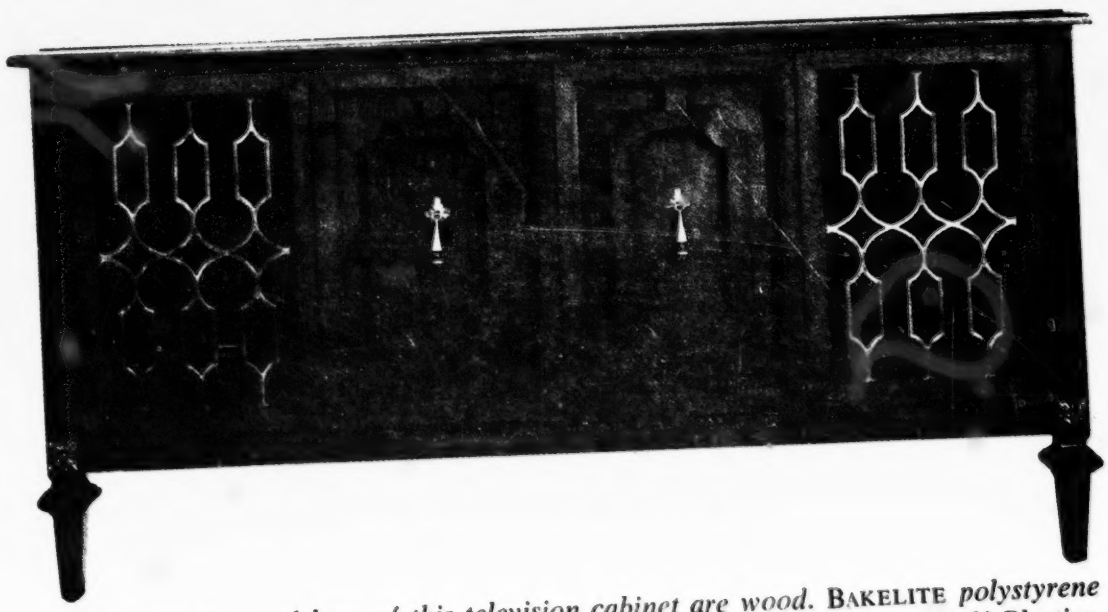
1. Many hours are involved on hand and machine carvings in the wood process.

2. Polystyrene carvings can be turned out at the rate of one per minute from an injection molding machine.

3. Intricate raised panels may be turned out at the rate of one per minute.

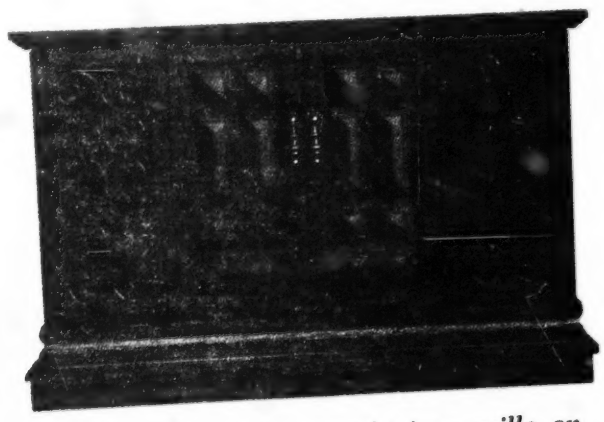
4. Louver doors can be molded at the rate of one per minute.

5. Intricate wrought iron replicas may be used without searching out another raw material combination.



The top, sides, and base of this television cabinet are wood. BAKELITE *polystyrene doors, panels, and "wrought iron" grille are all injection molded by Gulf Plastics.*

Louvers in this piece are single units. There are no wooden slats to come loose and no raw material was lost as sawdust.



The replica of a wrought iron grille on this cabinet was injection molded by Gulf Plastics from BAKELITE *TMDA-6560 polystyrene. Note the elimination of the time and labor to bend individual pieces of wrought iron and make 21 spot welds.*

C. Temperature conditions for heat deflection are of special importance to be used with wood products.

1. Bakelite TMDA 6560 (industrial coding) high impact plystyrene has the room temperature requirements to give long service life.

2. Heat deflections have now been refined to 185°F.

D. Finishing polystyrene components

1. Early experiments with wood finishes on polystyrene were caustic to the product.

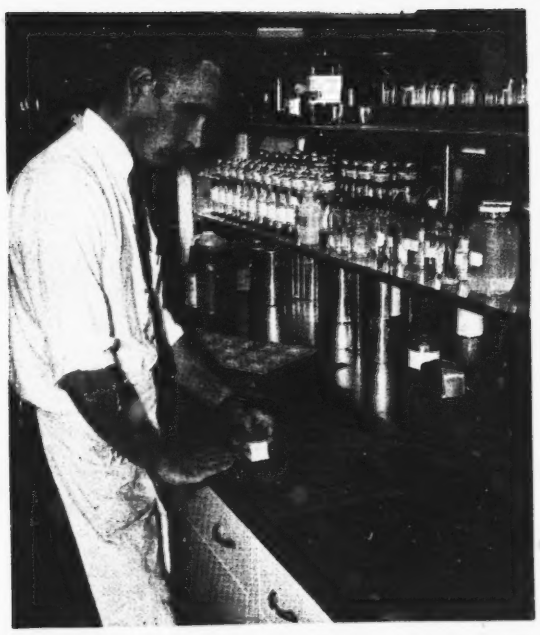
   a) Lacquer attacked the inherently soluble product.

   b) Crazing and etching were undesireable results.

2. Lilly Industrial Coatings Inc. has created a product called Acrylic Armor for plastic furniture componets.

   a) Acrylic Armor is a barrier coat called Acryloid B-66 that comes in 12 basic grades which is a product of acrylic ester resin.

   b) The barrier coat can be pigmented to provide the proper background color for subsequent finishing operations.



A Lilly laboratory technician checks the adhesion of a barrier coating to a plastic furniture part. In many finishes, Lilly uses Acryloid resins from Rohm and Haas.

After assembly of the table, a conventional wood varnish is applied to the plastic legs and the natural hardwood cabinet. The Lilly barrier coating allows manufacturers to apply a single topcoat system to both plastic and wooden components. This greatly simplifies finishing.

E. Considerations of machining polystyrene follow many of the same rules that would be standard with most thermoplastics.

1. Heat is built-up in machining polystyrene causing it to deformate.

2. Carbide teeth are used on saws with a small number of teeth.

3. High speed bollow ground teeth designed for plastic use are desirable.

4. Low speed belt sanders are necessary to reduce heat-friction build up.

I I I. FIBERESIN a product of the plastics division of the United States Gypsum Company is an engineered material that consists of wood fibers and thermosetting plastic resins. The resin consists of melamine and phenol formaldehyde. When subjected to high heat and pressure, the resins interflow to form a dimensionally stable solid plastic panel imitation wood, cork marble and patterns of plastic laminate.

A. No edge banding is required or needed.

1. The edge may be shaped to any profile desired with conventional tools, and the edge will withstand severe abuse.

2. The panel may be drilled, machined, cut and screwed.

B. FIBERESIN is a finished surface

1. No telegraphing lines appear from the under surface.

2. No repples or shadows appear.

3. A satin surface or soft textured effect may be obtained.

C. FIBERESIN top and bottom surfaces are balanced construction.

1. High hesistant melamines are used on top and bottom surfaces.

a) Resistance to heat (cigarette proof)

b) Scratching difficult

c) Stain resistant

d) Very high moisture resistance to water rings or delamination

e) Chemicals such as acids, alchol, grease, cosmetics, fingernail polish, lacquer and lacquer thinner do not penetrate the surface.

D. Stocked sizes of FIBERESIN

1. Available in all sizes of panels up to 48" x 96".

2. Thicknesses are made up in the sizes of 3/16", 7/16", 5/8", and 13/16".

E. Uses of FIBERESIN

1. FIBERESIN is used most extensively for all types of furniture, household, motel, hotel, contract and office furniture.

2. FIBERESIN is also used for laboratory counter-tops, computer enclosures, and wall panel.

DEVELOPED AND PIONEERED BY

FIBERESIN®
PLASTICS COMPANY

OCONOMOWOC, WISCONSIN

I V. High impact molded Polypropylene thermoplastic is a little remote to relate as a wood substitute but goes hand in hand with some of the more related products previously mentioned. Many containers are made of this plastic such as tool boxes, water containers, etc.

A. Impact strength will withstand a minus 20°F. or up to 220°F.

B. Material is dimensionally stable to permit molding a stick free, warp proof drawer box that can be assembled to a wood or other plastic component front panel.

C. Polypropylene is more resistant to stains and chemicals than polystyrene, making it valuable in hospitals and laboratories.

V. Urethane Wood is generally credited with the invention of urethanes, (pronounced yer'-a-thane) has within very recent months brought to the consumer market, a product that the average consumer has never heard of.

A. Ingredients or Chemicals

1. Polyol made from propyline oxide. Plyols are mixed with ingredients called isocyanate compounds to make foams, fibers, elastomers, coatings, and adhesives.

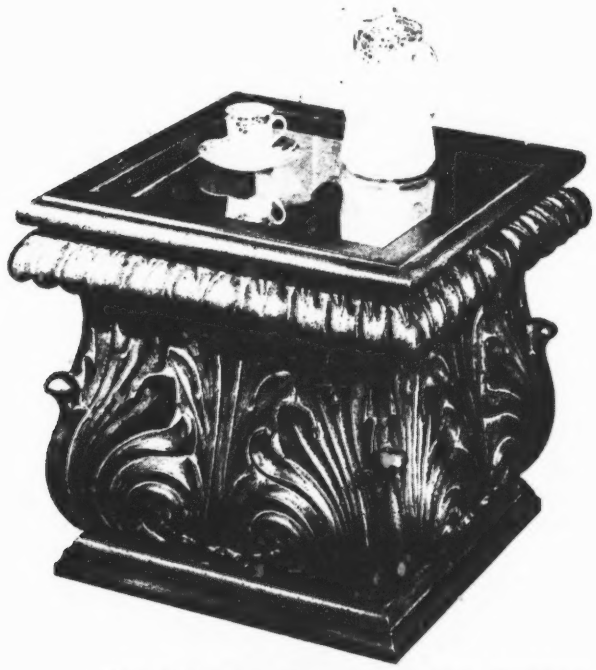
2. Each poly-esocyanate combination can produce a foam with a different density appearance and end use.

B. Rigid Foam

1. One combination of rigid foam has made it possible to produce furniture.

2. Urethane foam resembles wood in structure density and texture.

3. Furniture manufactures are using rigid foan for such things as chair shells, wall plaques, mirror frames, table legs and drawer fronts.



This table from Drexel Furniture's *Rapport* group has an Almond Gilt finish and is molded from urethane foam.

C. Urethane Wood Beams

1. One of the most current uses of rigid urethane is its use as an imitation wood beam for contemporary house construction.

   a) Manufacture of the urethane beam is now only being produced by a few major companies.

   b) Town and Country of Middle Village N. Y. makes solid 2 x 6's, solid 4 x 6's and hollow or channeled out 4 x 6's and 6 x 8's.

2. Prices range from about $1.90 per lineal ft. to $3.80 per lineal foot for the larger beams.

3. Massive looks of a real wood beam are genuine, but the material weight of the product is from one half to one pound per lineal foot.

4. Application is made by a caulking adhesive on the under side of the beam and it will adhere to any reasonably smooth surface.

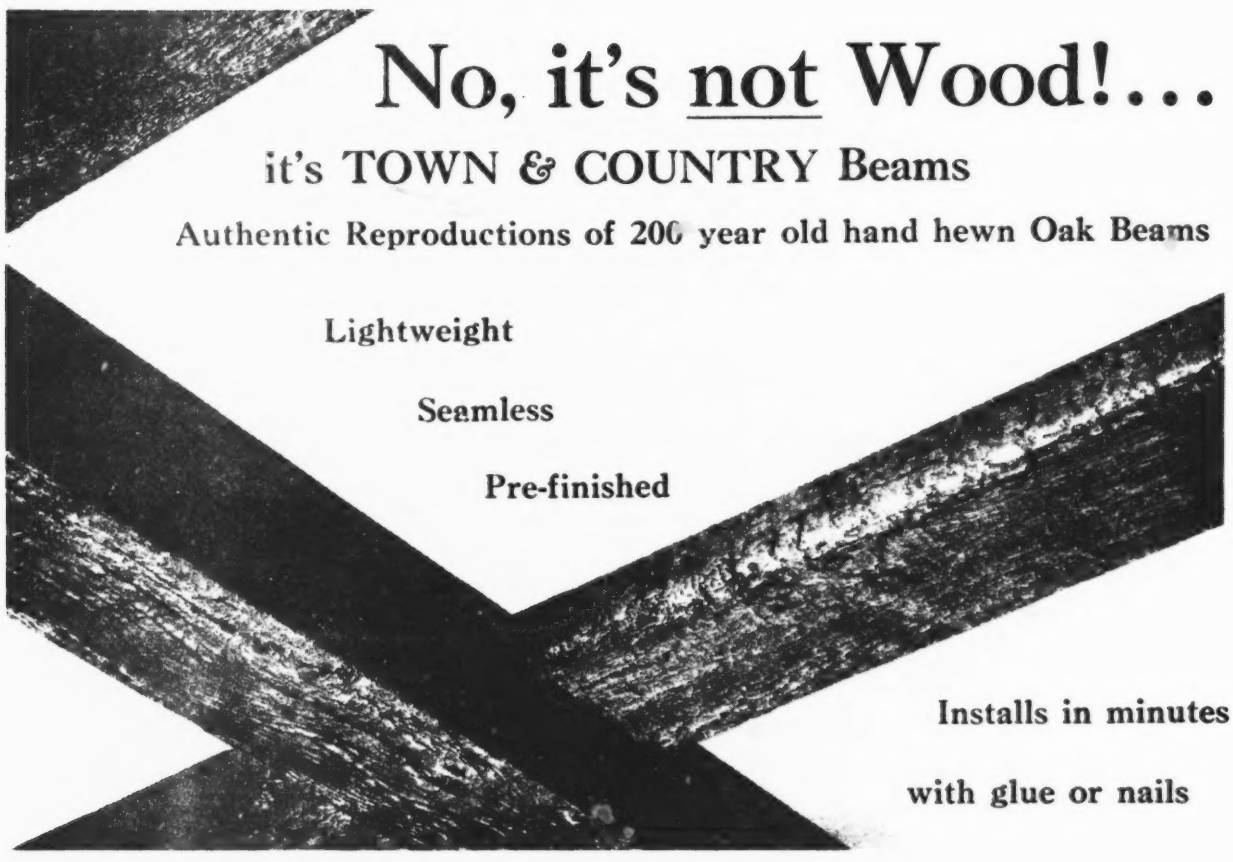
   a) The adhesive is applied and then stuck into place, removed briefly for tackiness to set up and then permanently placed into position.

   b) Application can be made by toenailing or by removable togel bolts.

No, it's not Wood!...

it's TOWN & COUNTRY Beams

Authentic Reproductions of 200 year old hand hewn Oak Beams



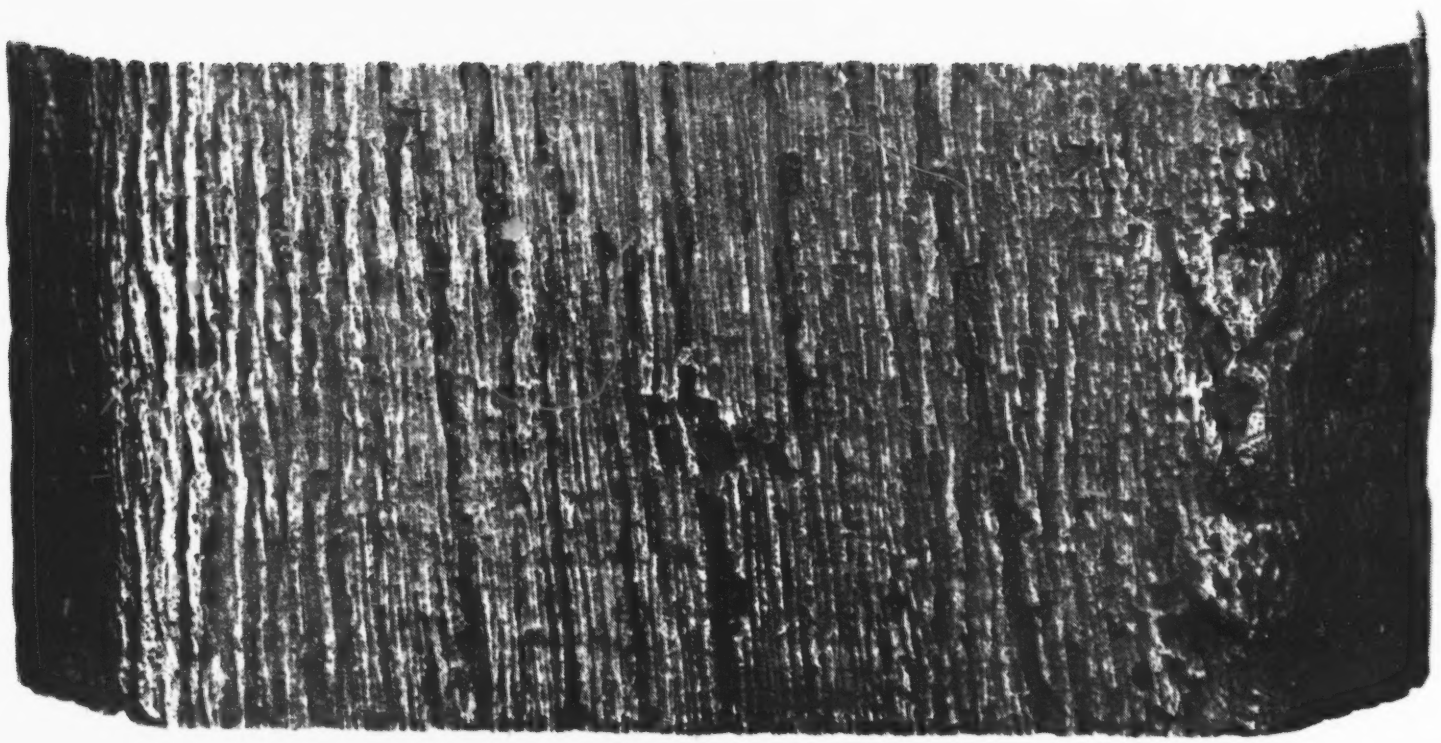
Lightweight

Seamless

Pre-finished

Installs in minutes

with glue or nails



5. Finishes consist of a prefinished surface at the factory with a dark black walnut stain that closely resembles the finish on old weathered beams, or beams can be ordered unfinished.

6. Cutting to length may be made with any fine tooth hand saw.

VI. Irradiated WPC (Wood Plastic Combination) is a new wood composite that combines the beauty and workability of natural wood with many improved properities that are derived from plastics and chemical compounds and the process of gamma radiation.

A. The first run of world's initial look at wood plastic combination by gamma radiation was made by the American Novawood Corporation in March 1966. (See "Furniture" May 1966, p. 10).

B. Other major contributors of the new product are Lockheed Aircraft Corporation and Dr. James Kent at the University of West Virginia. All three major contributors were sponsored by the Atomic Energy Commission. Wood sold under Lockheed-Georgia Company trade mark is known as "Lockwood".

C. The process by which wood is transformed into the WPC involves two steps.

1. Impregnation

a) The wood is placed in a sealed impregnation chamber similar to a wood treatment chamber. Vacuum is applied to remove air and other gases entrapped in the wood.

b) The monomer (plastic) is introduced under vacuum.

c) After a soak period, the vacuum is released and pressure is applied to help drive the monomer into the wood.

2. Polymerization or the radiation process

a) From the chamber the wood is transferred to an aluminum radiation canister and moved to the gamma irradiator.

b) Irradiation cause the plastic molecules to polymerize, producing a completed wood plastic unit.

D. Radio active danger or residual radio activity is absolutely no hazard. It leaves the end product completely free of all radio-activity.

E. One of 22 different grades of acrylic monomers is used to make WPC. The monomers used are of methyl methacrylate (MMA), vinyl acetate (VA), styrene-acrylonitrile (SAN) and a few acrylates. Such monomers are found in latex paint, floor polishes, automotive finish, adhesives, printing inks, paper coatings, textiles and leather finishes.

F. Types of wood best suited for the WPC process are ash, basswood, beech, yellow birch, soft elm, hard and soft maple, southern yellow pine, white pine and sycamore.

G. Finishing WPC wood.

1. WPC may be made up into the natural wood color with a clear monomer.

2. Wood colors can be obtained by adding small amounts of dye, to create new decorator colors.

a) In many species sharp differences occur in the amount of plastic or polymer loading which is impregnated into the heartwood and sapwood.

1) If a clear polymer is being used not much difficulty is noticed between the heart and sapwood.

2) Dark colors show a distinct color change going from heart to sapwood.

b) Color change can be controlled somewhat by longer impregnation periods.

H. Economics of WPC process call for low moisture content in the wood.

1. Excessive moisture raises the cost of the gamma ray process because water absorbs the rays.

2. 8% to 15% M.C. before conversion by gamma radiation is the recommended quality control.

I. Gluing of WPC Materials

1. Gluing is accomplished by the same process as ordinary lumber products.

2. Phenol-formaldehyde-resorcinol resins in general, appear to give the best bonding results.

3. Animal-based and casein glues provide poor bonding results.

4. Some successful experiments with the resin or monomer components of WPC that is impregnated in the wood were dissolved in tight joints by a solvent that made a satisfactory bond.

J. WPC advantages to consider.

1. As more polymer is added nearly all physical properties of wood are improved.

   a) dimensional stability

   b) resistance to moisture

   c) compressive strength

   d) bending and shear strength increase from 50% to 200%

   e) built in finish

   f) ease of repair or refinishing

2. A very attractive finish may be obtained by machining, sanding, and buffing only. No surface additives are needed.

K. Cost Evaluation of irradiated wood

1. It is an entirely new product concept to compare on cost comparison.

2. It is unfair to compare WPC to the cost of natural wood alone.

3. Plastics must be considered along with full recognition of finishing costs, refinishing costs and life expectancy.

GLOSSARY

1. Barrier Coat - An undercoat applied to plastic wood components to prevent crazing.

2. Crazing and Etching - Pattern formations of broken lines in a wood finishing coat.

3. Irradiated - Process used to accomplish polymerization.

4. Monomer - Plastic chemical compound.

5. Polymer - Agent to be polymerized or to be combined with another agent by a particular chemical process.

6. Sub-strate - The underlayment or build-up, underlying a finished surface.

7. Telegraphing Lines - Line caused by improper application or mixture of sub-strate material.

8. Thermoplastic - Plastic that may under certain conditions return partially or wholly in its original form.

9. Thermosetting Plastics - Plastic material that cannot be returned to its original status.

BIBLIOGRAPHY

Barrett, L. G., "W P C; Irradiated Wood-Plastic Combinations" Furniture Methods and Materials, May 1966, Vol. 12, No. 5. pp. 10 - 12.

Ponikvar, Ade, "What You Should Know About Plastic Furniture" Furniture Design and Manufacturing. August 1966, Vol. 38, No. 8. pp. 38-45.

Ponikvar, Ade, "What You Should Know About Plastic Furniture" Furniture Design and Manufacturing. September 1966, pp. 62-64.

Bakelite Review. "Wood Grain Beauty in Polystyrene" Octover 1967, pp. 8-9.

Dow Diamond. "Urethane" No. 1, 1968, pp. 14-17.

Furniture Methods and Materials. "Fiberesin Offers Design Freedom With Solid Plastic Panels". May 1966, Vol. 12, No. 5. p. 44.

Rohm and Hass Reporter. "The Beauty of Wood--The Durability of Plastic" Vol. XXV. No. 3, May • June, 1967, pp. 24-27.

Rohm and Hass Reporter. "Acrylic Armor For Plastic Furniture" Vol. XXVI • No. 1, January • February, 1968, pp. 21-23.

INDUSTRIAL SOURCE ADDRESSES

Fiberesin Plastics Division
United States Gypsum Company
Box 88
Oconomowoc, Wisconsin 53066

Lockheed-Georgia Company
Nuclear Products Laboratory
Cawsonville, Georgia

Plastic Industries Incorporated
P.O. Box 669
Athens, Tennessee 37303

The American Novawood Corp.
2432 Lakeside Drive
Lynchburg, Virginia 24501

Town and Country Reproductions, Inc.
69-19 Metropolitan Avenue
Middle Village, N.Y. 11379
Phone: (212) 894-9320

OTHER PERIODICAL SOURCES FOR REFERENCE

Modern Plastic Magazine

Plastic Design and Processing

Plastic World

Plastic Technology

Furniture World

Furniture South

INDUSTRIAL SOURCE ADDRESSES

Fiberesin Plastics Division
United States Gypsum Company
Box 88
Oconomowoc, Wisconsin 53066

Lockheed-Georgia Company
Nuclear Products Laboratory
Cawsonville, Georgia

Plastic Industries Incorporated
P.O. Box 669
Athens, Tennessee 37303

The American Novawood Corp.
2432 Lakeside Drive
Lynchburg, Virginia 24501

Town and Country Reproductions, Inc.
69-19 Metropolitan Avenue
Middle Village, N.Y. 11379
Phone: (212) 894-9320

OTHER PERIODICAL SOURCES FOR REFERENCE

Modern Plastic Magazine

Plastic Design and Processing

Plastic World

Plastic Technology

Furniture World

Furniture South